SCIENCE:

A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

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PUBLISHED AT
229 BROADWAY, NEW YORK.
P. O. Box 3838.

SATURDAY, NOVEMBER 20, 1880.

THE SIGNAL SERVICE.

The question of the appointment of a Chief Signal Officer in the room of the late General MYER is immediately interesting. It is a question which has a direct bearing upon the scientific activity of the country, as well as upon the more important and more practical matter of making accurate weather forecasts, and displaying storm signals for the benefit of commerce.

The first and greatest use of the Weather Bureau is to make itself valuable to every individual in the United States, through accurate and prompt predictions, and thus to justify the annual expenditure of nearly $1,000,000. At present about 80 per cent. of the predictions are fulfilled, which is a fair showing—indeed, a very creditable one. Most unprejudiced persons, familiar with the routine of the Signal Service, will admit that General MYER had carried the efficiency of the service about as far as it could have been carried under an organization like his own; and the country may feel confident that, whoever is appointed to succeed him, the use fulness of the Signal Service as a Weather Bureau, that is to predict storms for the benefit of commerce, agriculture, etc., will not be greatly diminished. The present routine is so well established that we may be sure for some time at least, of the same proficiency.

But meteorologists know that this percentage can be increased. To do this, scientific investigation must be carried on in various ways, and by competent persons. The vast material now accumulated by the Bureau must be examined, discussed, and the laws—empirical and other—deduced. This can only be done under intelligent and sympathetic direction, by men trained in the methods of physical and mathematical science. This is the first great want. But again, the Signal Bureau has grown, under General MYER's vigorous administration, to be a vast machine, composed of many parts—officers and men—and controlling many instruments. For example, the many military telegraph lines of the West, several thousands of miles in length.

Again, the service must look not only to the continuance of peace at home and abroad, but to the contingency of a war in which trained signal men may be wanted. The military post of Fort Whipple, Virginia, is entirely devoted to the training of the enlisted men of the signal service for their varied duties as meteorological observers, signal men and military telegraph men, directly under the charge of officers of the army, who themselves become familiar with these varied and important duties.

These and other obvious reasons make it plain that, if the proper scientific efficiency of the Weather Bureau can be maintained it will be highly advantageous to keep the Signal Office where it now is, *i. e.* as an important Bureau of the War Department.

At present three different plans are advocated for the filling of the existing vacancy:

FIRST, The appointment of a colonel of the line who has had experience in the plains, and to whom the Brigadier General's commission would be a fitting reward; Generals HAZEN and MILES are mentioned in this connection.

SECOND, The appointment of some officer who has learned the art of administration during our war, by commanding large bodies of troops, and whose duties and studies since the war have been of a sort to fit them for this position: Generals ABBOT, PARKE, COMSTOCK, WARREN and POE, of the Engineers, are of this class.

THIRD, The appointment of a scientific civilian meteorologist, as Prof. Loomis, Prof. Cleveland Abbe or Dr. Daniel Draper.

Two faculties are required in the person to be appointed: First, he must be an able administrator; and secondly, he must be capable of understanding and directing scientific investigations.

If the appointment is made from the first class named above, it is likely that we shall have good administration, and that the present efficiency of the service will be maintained, but that no advances will be made. It is difficult for the necessary forward steps to be made under the direction of men in middle life, now first called upon to examine and approve of the methods of physical science. If the

appointment is made from civil life, it is likely that tne men of great and acknowledged ability then named, while devoting their attention to the many troublesome details incident to the management of a large body of men,—would deprive science of the benefits to be derived from minds which have been engaged for a lifetime upon one branch of research.

The best interests, both of the people, who pay for the bureau, of the army, to which it is a school of instruction, and of science, which looks to it for a thorough reorganization of its old methods (which were often clumsy and antiquated) and for a decided step in the direction of investigation and research,—would probably be most surely advanced by the appointment of one of the accomplished Officers of Engineers named above. Each of these gentlemen is entirely competent to administer the complicated business of the office, as each of them commanded, during the war, a brigade, division, corps, or even army, and as each of them since the war has been engaged in work where strictly scientific ability is required. Each of them has shown in both capacities marked strength, and the appointment could not go wrong if made from their number.

It is not the purpose of this article to advance the personal claims of any one, but to point out the direction in which, after careful thought, it seems the signal service may be led to the maximum of usefulness and efficiency, both to the people and to science.

TO ASTRONOMERS.

The value of the work performed by the astronomers of the United States is now fully recognized, and has become an important factor in the progress of astronomy. They have at their command some of the finest instruments that have been produced, while their power to make good use of them is testified by the brilliant discoveries which they have recently made, forming most important records in the annals of the science.

We are glad to find that the publication of this journal meets an important want which is admitted to exist by astronomers, viz., a ready means of communication. We have received letters from Mr. Burnham, of Chicago, and from others, on this subject, and to-day Mr. Swift, of Rochester, makes the following statement, in a letter to us, enclosing a valuable astronomical paper:

"Of course you are aware that there is not, in this country, a single journal devoted exclusively to astronomy; and for ephemerides of comets we have to depend on the *Astr. Nachr.*, but as it is printed in German no amateur takes it. Now if you would give a prompt ephemeris of all comets so that amateurs can ascertain where they are, or if on the discovery of every new comet a special circular be sent immediately to each subscriber announcing it and giving position, direction and rate of motion, and if everybody knew they could and would be thus informed, hundreds would take it ["SCIENCE"]. It would be a great satisfaction for them to know that they are to be kept weekly posted on a subject not mentioned by a single weekly publication on this continent."

"It is a great consolation to know that there is no comet in the sky, for it relieves him of all suspense, and it is equally so to be told, at so cheap a rate, where it is and all about it. I could immediately notify you of all discovered by me, or telegraphed to me, from the Smithsonian Institution. I shall be pleased to call the attention of my friends, both here and elsewhere, to your JOURNAL, to increase its circulation that it may be liberally sustained."

In regard to the above letter, we beg to announce that it will be our aim in the future to comply with the suggestions so ably expressed, and indeed have partially anticipated them.

We have, by courtesy of a distinguished member of the Naval Observatory at Washington, arranged for a weekly report compiled from their library by a gentleman perfectly familiar with practical astronomy, and in connection with the Smithsonian Institution and all astronomers at Washington. This will embrace a *resumé* of both foreign and home literature, and especially will give immediate notice of astronomical information received at that establishment.

Professor Asaph Hall has recently furnished us with two communications, and we trust will in the future continue to favor us with notes. Professor Edward S. Holden will also occasionally give us the benefit of information coming within his knowledge. Professor Stone, of the Cincinnati Observatory, has already placed us under many obligations for constant communications, and up to date is one of our most esteemed correspondents. Professor Burnham, of Chicago, has also engaged to give us astronomical information in his special department, and is now only delayed, by the condition of the atmosphere, from making some important observations with the great Dearborn Equatorial, to be published in "SCIENCE." Professor Swift, of Rochester, as his letter states, will communicate to us immediate notice of results obtained with his new and

magnificent instrument by Alvan Clark, and lastly, Mr. Sawyer, of Cambridgeport, undertakes to report on his interesting systematic observations of meteoric phenomena.

As "SCIENCE" is published weekly this information will be mailed to astronomers every Friday evening, and should important astronomical information reach us early in the week, we undertake to mail a special despatch, giving the information mentioned by Professor Swift. We think this programme will be a prompt compliance on our part, with the request made in Professor Swift's letter, and we trust will be acceptable to astronomers; we further ask the co-operation of all possessing, or in charge of, observatories to put themselves in communication with us and make suggestions, as it is our desire to make the most perfect arrangements, and to offer in "SCIENCE" a medium for universal intercourse for those engaged in astronomical studies.

In regard to other branches of science, equally important arrangements are being made and will be shortly announced.

CONTRIBUTIONS TO ENCEPHALIC ANATOMY. —THE OBJECTS AND METHODS OF A STUDY OF THE ICHTHYOPSIDEAN BRAIN.

By E. C. SPITZKA, M. D., NEW YORK.

II.

Inasmuch as Huxley's class of the Ichthyopsida contains the lowest of the living vertebrate forms, it would appear one of the most important undertakings for the cerebral anatomist to determine the structural relations of the brain, spinal chord and principal nerves in that class. In fact, *a priori*, the student might conclude that the anatomy of a a simple brain like that of a fish would represent a sort of rough and rudimentary sketch of the fundamental features of the higher mammalian brain, and that for this reason alone, its study would be essential to the human anatomist.

Nothing could be more erroneous!

Any one familiar with the visceral and osteological anatomy of the fish tribes will bear me out in the statement, that however convenient it may be to pigeon-hole the Amphibia, Elasmobranchi, Teliosts, Ganoids, Dipnoi and Marsipobranchi in one great class, on the strength of the formal common character, that they have no amnion at the embryonic period, and always have gills at some time of or throughout life,* that there are actually more fundamental diversities between the different primary groups of this class than between at least one group of this class and the Sauropsida.

As it would be difficult to find an archetype of the vertebral skeleton in any ichthyopsidean, so it is a task requiring far more discrimination and careful study than is generally devoted to this subject to determine the cerebro-spinal archetype in any member of this group, aside from the protean amphibians. For there are greater differences between the architecture of a shark's and a pike's, a herring's and a sturgeon's, an electric eel's and a lamprey's, than between an amphibian and a mammalian brain. While the differences between the brain of a frog and of a man can almost all be referred to quantitative variations in the relative proportions of similar and homologous parts, the differences between the brains of the other animals named are of a qualitative character. It actually becomes a question whether a homology between the parts of an amphibian and of a shark's brain can be established.

Notwithstanding the difficulties enshrouding this subject, both writers on human and on comparative cerebral anatomy skim over the subject with a remarkable *nonchalance*. The latest compilation on the human brain * neglects any mention of the fact that the cerebral lobes of fishes are commonly solid, informs the student that there are symmetrical halves in these animals constituting a cerebellum, and repeats the statements of as old an author as Cuvier without the slightest reference to the recent controversy on the homology of the fish's brain, in which Gegenbaur, Fritch, Stieda and Maclay have taken part.

The text book on Zoology used at most of our colleges, Packard's work, on passing through the ordeal of criticism at the hands of Wilder, is shorn of nearly every statement it makes regarding the fish's brain, since scarcely a reliable one is contained in the volume.

The question of the true homology of the fish's brain being still *sub judice*, the human cerebral anatomist can only lose time, and writers on the human brain only confuse their students by devoting attention to this problematical subject.

It is a legitimate field of study for the zootomist alone, and in its morphological respects the subject bids fair to prove rich in surprising and suggestive results, which, when once established on the basis of observation, may be utilized by the human anatomist and physiologist in generalization.

The questions to be determined will appear from the following; their answer is as yet a desideratum.

1st. A careful surface study of the brain of at least one representative of each great group should be made. Careful and enlarged representations of each such brain as projected in the five cardinal views, namely, the dorsal, ventral, lateral, anterior and posterior should be drawn, and the brains preserved for reference, in the manner to be detailed.

2d. A median section of each such brain should be made, and delineated, in order to expose the axis contours of the ventricular cavities.

* These are the only constant characters separating them from other groups, and it is even doubtful whether we are justified in denying the existence of the morphological representative of the amnion in all the anamnia.

* "The Brain as an Organ of the Mind," by H. Charlton Bastian, 1880.

3d. A longitudinal section nearly parallel with the former, running from the anterior prolongation of the olfactory bulb through the middle of *each* cerebral and optic lobe, and striking the lateral convoluted mass of the medulla oblongata, could be made from the same brain, as a supplement to the elucidation of the internal contours.

4th. One horizontal dissection exposing the ventricular floors, from above, and another exposing the ventricular roofs from below, will still further clear up these relations.

5th. A series of transverse sections, taken perpendicularly to the peduncular axis, will be essential to a comprehension of the relations of the ventricles and deeper parts for each altitude. The sections should be taken at distances of from one to three millimetres apart, according to the size of the brain, then preserved in separate bottles and labeled in numerical order.

All these preparations should be made from brains hardened in absolute alcohol, and the dissections should be made after the brain has been kept thus for one month, if the working season is in summer, and one or two weeks or even a few days, if the season is winter.

My plan, when engaged in this and similar work, has been to expose the cranial cavity by cutting away the surrounding parts with a strong knife until the brain level is reached. This requires very little practice. Then the lateral walls are broken away with a forceps, or cut away the same knife, and the student may then clear up the tracks of the cranial nerves for a short distance. The brain is not to be removed from the skull base, but left in contact with it, a smooth round head of a needle may be employed to bread up the arachnoid attachments there, and facilitate the penetration of alcohol to the basilar parts, but this is all that should be done. The brain must be immersed in alcohol, with the base of the skull in connection therewith, at least by means of the emerging nerve roots, else the topography may become disturbed.

The membranes (excepting the dura of the convexity) should not be touched, for it is desirable to trace their connections with plexiform structures penetrating the fissures and cavities of the encephalon, as these may be of service in explaining certain homologies.

Alcohol is selected as the preserving fluid for the reason that it does not render the specimens too brittle for coarse dissection, which the chromic salts do, nor distorts the contours as does glycerine.

The transverse sections can be made in a microtome, moving the piston the distance of the thickness of the required section, before each section is cut. Previous to each cutting, the imbedding matrix should be removed to a little below the level of the section. All other sections can be made without a microtome, it being well, however, to fix the brain in a wax or a paraffine layer, poured on a glass plate. Adherent particles of the material thus used can be subsequently removed with turpentine, when the specimen is prepared for permanent preservation. It is needless to add that all sections and dissections can be done a hundredfold better under the surface of a fluid like alcohol or water, than by simply wetting the knife with these fluids, as text-books direct.

All the work so far mentioned is only preparatory however. It is merely destined to furnish on the one hand a topographical guide to the more important work which is to follow, on the other to supplement the ascertained relations of ganglionic masses and fascicular tracts by a plastic conception of the encephalic segments which contain them. The work which is to follow is far more tedious, but also far more important; its methods are those employed in studying the microscopic anatomy of embryos.

For the purposes of microscopic anatomy the brains of smaller species are as preferable, as those of the larger species are desirable for the coarse anatomy. The brain of a sturgeon twelve inches long, will show all the microscopical details as well, and be easier of manipulation than that of one twelve feet long. The latter's had best be devoted to naked eye study.

If the weather is cold, the animal perfectly fresh, and the specimen can be kept in a temperature near the freezing point (it should never reach or drop below the latter,) the brain can be immediately transferred to a solution of chromic acid of a light sherry color. In my experience this tint, tested in a two ounce graduate, is a far more reliable gauge than any weighing by so many grains to so many ounces, that is ordinarily recommended. After staying a week in this solution, it is transferred to one of bichromate of potash, having the same color. Here it remains, care being taken to have always at least one hundred times as much fluid volume as specimen volume, until the desired degree of hardness is attained. The latter is hard to describe in words, but an adequate conception can be best conveyed by saying that the specimen should be unyielding to pressure, and yet not altogether inelastic. The membranes will now separate readily, and the specimen, first washed in water, is transferred to a neutral (long stood, and repeatedly filtered and mouldless) carmine solution, so concentrated as to appear black in a depth of six inches. Here the specimen is left for from one to three weeks, according to the size of the brain. Then it is again washed, put in water containing two per cent. of glacial acetic acid for twenty-four hours, washed again, transferred to proof spirit for a day, then finally to absolute alcohol, until such time as the observer is ready to make his sections.

When this time arrives (and it is best not to defer it over a month) the brain stained and hardened as it is, is transferred to clove oil, which penetrates and drives out the alcohol in a few days. The translucency of the specimen is a sign that this has been accomplished. It is then taken off, the superfluous clove oil drained from the surface, and imbedded in a microtome with paraffine. The superfluous matrix being removed with each section, the cutting is done with turpentine, and each section, stained and transparent, can be transferred to its appropriate slide and mounted, so that the order in which each section belongs is preserved. This is an important advantage.

If the weather is warm, the brain should be sub-

mitted to absolute alcohol for a day before entire removal from the skull, then put in a mixture of methyl-alcohol and bichromate of potash, of a muddy beer color (thirty grains of the salt to the ounce of alcohol) for a week, and subsequently, for a variable time according as the specimen will harden, to simple Müller's fluid. The staining, cutting and mounting can be done exactly as in the former case.

Specimens prepared by the first method of hardening will furnish better results for the medulla, those hardened with the second will yield more complete specimens of the higher ganglia. It is a well known fact that fluids that will harden the medulla oblongata well will sometimes fail to render the cerebrum and mesencephalon fit for cutting.

Of course the most important series of sections will be one taken transversely to the peduncular axis. This should be made first, therefore, and studied in conjunction with the delineations made from the coarse specimens. Now the student having familiarized himself with the precise topography and extent of every ganglion, cortical expanse and fibre mass, is ready to proceed to more complicated inquiries, that is to study the *relations* of fibre masses. How he may proceed where a fasciculus does not run in a straight plane, I have indicated in a previous contribution to this journal.*

It is needless to say that in addition to these methods, which may be called systemic ones, inasmuch as they are calculated to reveal homologies and relations, that all other methods of hardening and staining may be used to study the finer and finest histology. They are of less importance, however, both to the zootomist and neurologist, than is generally supposed.

Now a word as to the objects of such an inquiry, for unless the investigator has a definite point in view, and a provisional notion of the subject he intends to develop, his work will be barren of result, save he stumble on some revelation accidentally.

a. The close relation between the cerebral lobes and the olfactory lobes of fishes may, if studied in all the groups, particularly the lampreys, lead to the establishment of a homology with the so-called cerebral lobes of the higher invertebrates.

b. The fact, which we have every reason to suspect to be a fact, that the cerebral lobes of fishes are the true homologues of the cerebral hemispheres of the mammalia, sauropsida and amphibia, requires to be definitely established. Prof. Burt G. Wilder questions this homology, on the ground that the cerebral lobes of bony fishes are solid, and contain no ventricles. That so acute an observer, one to whom we owe so much in the line of correction of gross errors which have found their way into standard text books, could lean his objection on such a doubtful basis, shows how catholic must become the principles, if I may so term them, of cerebral anatomy. The embryological development of the fish's brain presents features which no other vertebrate brain exhibits in the course of development, namely, the entire central nervous axis is apparently solid. In truth it is hollow, but the cavity is a mere slit, the walls of which are in contact, and when the cerebral lobes become solid they do so by the fusion of these walls and the obliteration of the slit. The ventricle is therefore not an essential feature of the cerebral hemisphere, and as if to prove this fact beyond a doubt, we find that among animals as nearly related as sharks, some have true ventricles in these lobes communicating with the third ventricle, while others have them as solid as the bony fish.

c. The derivation of the olfactory bulb, a structure often and unwarrantably confounded with the olfactory lobe, can be best studied in fishes.

d. The same applies to the cerebral epiphysis and hypophysis, still known by the improper titles of pineal and pituitary glands.

e. The relations of the peculiar *lobi inferiores* to the optic nerve, and the asserted homology of the *corpora candicantea* require confirmation.

f. The question of the homology of the cerebellum and optic lobes, which is in a very unsettled state to-day, is yet unanswered. Wilder, in his paper on the brain of the *Chimæra*, has exposed the fallacious interpretations which most authors have made in this regard. His essay will prove valuable to those engaged in this inquiry. Possibly the discovery by myself of the entire distinctness of the post-optic and the hitherto unknown inter-optic lobes in reptiles, from the optic lobes proper, may assist in unraveling the true relations.

g. Since among fishes we find many examples of remarkable development of the periphery, I need but instance the rostrum of Spatularia, the great lateral expansions of the skate, the asymmetry of the Flounder, the rudimentary eyes of Amblyopsis, the marsupium of the Hippocampus, and the immense jaw of the Angler, an inquiry dealing with the relations of nerve centres to the projected peripheries may be expected to furnish many suggestive facts bearing on the projection doctrine.

All through these lines it will be seen that as in every other branch of morphology a study of embryonic development is an essential to a proper knowledge of the fish's brain. A brief consideration of the methods to be employed in this field of the study will not be out of place.

Spawn can be obtained living from our fish hatching depots, whose superintendents will be found very obliging towards those requiring material for scientific study. The different stages of development, extending to beyond the period when the young fry escapes, can be obtained by permitting the ova to develop under the eye of the observer in a hatching trough.

The ova of bony fishes are dropped into a solution of chromic acid, or Müller's fluid; better, a few specimens are taken out each day and dropped each into differently strong solutions of the former and into the latter. I know of no standard strength that will yield uniform results, and have while working in this field in Vienna lost thousands of ova by following the routine directions.

From the chromic acid and Müller's solutions the spawn is transferred to alcohol in from two to

* Part I. of this series, *Journal of Nervous and Mental Disease*, 1887, p. 668.

twelve days, the younger the germ the less time should it be exposed to chromic acid. After having been in alcohol a week it is transferred to a sherry wine colored solution of bichromate of potash for a period sufficient to harden it.

With a cataract needle the investigator will then cut a trench around the embryo, cutting through the vitelline membrane, which fixes the embryo to the vitellus, and then lift it away and remove it from the latter, which, brittle and crumby, cannot be cut. The staining in a solution of carmine, as described for adult brains in this paper, will require from one to four days, according to the size of the embryo. Of each stage three series of sections are necessary, one transverse, one horizontal, and a third, the most important, sagittal, that is parallel to the median plane.

All these minutiæ, however wearisome they will prove, are necessary, and he who has thus with his scalpel, reagents and razor, constructed an open volume of natural specimens, will find himself richly rewarded by the richness in detail, the manifold character of the morphologies, and the suggestive character of the relations exposed.

The material for such a study can be obtained in a fresh state from no one locality. The student residing in New York will have to take a vacation trip to the Mississippi; he living in Chicago a corresponding trip to the Atlantic coast.

In the West he will find the great lake catfish, the lake sturgeon, the Amia calva, the gar-pike, and the remarkable spatularia, the brains of all of which should be studied. Possibly he may obtain the fresh water lamprey (Hylomyzon), but one brain which he should not neglect is that of the blind fish of the Kentucky caves, whose examination is destined to clear up somewhat the true relations of the *lobi inferiores* and the optic lobes. On the Atlantic coast all the bony fish, obtainable in the fresh waters of the West, besides a rich variety of salt water forms, also the lamprey, the shark and ray are obtainable. A trip to the Bermudas or the Florida coast, occupying about two weeks, will increase the student's *repertoire* with a host of tropical and sub-tropical genera.

WEIGHT, SPECIFIC GRAVITY, RATES OF ABSORPTION, AND CAPABILITIES OF STANDING HEAT OF VARIOUS BUILDING STONES.

By Hiram A. Cutting, Ph. D., State Geologist Vermont.

Having during the past year instituted, and carried out, a series of experiments to ascertain, as nearly as possible, the capabilities of the various materials used in the construction of so called fire proof buildings, to stand heat, I submit, in tabulated form, the result of such experiments, hoping they may be of use to the architects, quarrymen and Insurance companies of our country, and also of some interest to those interested in science.

In connection with the capabilities of the various building stones to stand fire and water, I have taken their specific gravity, and weight per cubic foot, so that the identity of the various stones could at any time be compared, and if in the working of a quarry there was a change in gravity, or weight, that it could be easily detected, and thus all who choose could know whether the tests given would apply or not.

I have procured sample specimens of the most important building stones in the United States, and Canada, and, after dressing them into as regular form as possible, three by four inches, and two inches in thickness, I have taken their ratio of absorption, which ratio I have expressed in units of weight, according to the amount of water taken up. If 450 units of stone absorbed one unit of water, I have expressed it thus: 1 + 450, meaning that the stone weighed 450 units when immersed, and 451 when taken from the water.

To accelerate the process of absorption I have placed the specimens in water under the exausted receiver of an air pump. I find that in this way as much water is absorbed in a few minutes as in days of soaking. When specimens were removed from the water, I have, before weighing, dried their outsides with blotting paper. In relation to the specific gravity, I have not followed "Gilmore's" rule in full. He weighed the specimens in air, immersed them in water, and allowed them to remain until bubbling had ceased and then weighed them in water, after which he took them from the water, dried them outside with bibulous paper, and weighed them again in air. From this last weight he subtracted the weight in water, dividing the dry weight by the difference.

This gave a specific gravity subject to two sources of error. I have followed the more frequent custom of weighing the dry stone, using pieces of two or three pounds in weight, and then immersing them in water. After the usual saturation I have taken their weight in water, subtracting it from the dry weight in air, and then dividing the dry weight by the difference. This gives the specific gravity of the rock itself, as usually found, which is what we desire, and I believe as it would generally be in buildings constructed of the given material. The specimens were previously dried by long exposure to a temperature not exceeding 200° Fah. To verify this I have taken specimens from the quarries direct, and after weighing, have brushed them over with paraffine dissolved in naphtha, weighing them again so as to ascertain the exact amount of paraffine, which made no visible change in the stone, other than to keep out water. I have then weighed in the usual way, and thus obtained the exact specific gravity of the stone as in the quarry, and I find my method used, as stated, to give the best results, and so have adopted it.

After this I have placed them in a charcoal furnace, the heat of which was shown by a standard pyrometer. In many instances I have placed them side by side with dry specimens, but have been unable to note any marked difference in the action of heat, beyond this, that the dry specimens became sooner heated, I have, however, no doubt that the capacity of a stone to absorb water is against its durability, even in warm climates, and vastly more so in the changeable and wintry climate of New England. It is here often frozen before any considerable part of the moisture from Autumn rains can be evaporated,

When the specimens were heated to 600° Fah., I have immersed them in water, also immersing others, or the same, if uninjured, at 800° and 900°, that is if they are not spoiled at less temperatures. I find that all of these samples of building stones have stood heat without damage up to 500°. At 600° a few are injured; but the injury in many cases commences at or near that point. When cooled without immersion they appear to the eye

to be injured less, but are ready to crumble, and I think they are many times nearly as much impaired, and always somewhat injured, when water produces any injury.

I would remark that my experiments with granites show that there is quite a range in their capabilities of standing heat, a range in fact much greater than I anticipated. With the sandstones the difference is also marked, as is their power of absorption. When exposed to the heat wet, they show a marked difference in the time required to heat them, the saturated ones seeming to resist the heat for a time; but when equally hot they crumble the same as those not previously saturated. Their relative worth can be seen by the table. The conglomerates stand heat badly; while the limestones and marble stand best of all (up to the point where they, by continued heat, are changed to quick lime) except soapstone, and a species of artificial stone made under the McMurtire & Chamberlain patent. The indications are, from this and other samples of artificial stone, that it may be possible to make an artificial stone cheaper and better for fire proof buildings than our native quarries furnish; and we hope this possibility may receive attention. But comments are useless, as the facts set forth in the tables speak for themselves.

I give you results in tabulated form below.

GRANITES.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
				Lbs.		Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1	Light colored	Hallowell, Me	2.638	164.8	1+790	800	900	950	1000	1100
2	"	Fox Island, Me	2.642	165.1	1+680	700	800	850	900	1000
3	Denning's Quarry	Mt. Desert, Me	2.631	164.1	1+716	800	850	950	1000	1100
4	Light colored	Rockford, Me	2.600	162.5	1+482	600	800	850	900	950
5	Red	Red Beach, Calais, Me	2.636	164.7	1+500	800	850	900	950	1000
6	Light colored	Oak Hill, Me	2.526	157.8	1+310	800	850	900	950	1000
7	Red	Stark, N. H	2.631	164.1	1+534	600	700	800	850	950
8	Colored medium	Concord, N. H	2.636	164.7	1+778	800	900	950	1000	1200
9	Sanborn's Quarry	Plymouth, N. H	2.649	165.5	1+685	800	900	950	1000	1200
10	Carter's Quarry	Ryegate, Vt	2.647	165.4	1+790	800	900	950	1000	1200
11	"	Woodbury, Vt	2.654	165.8	1+784	800	900	950	1000	1200
12	Wetmore & Morse's Quarry	Barre, Vt	2.651	165.6	1+720	800	900	950	1000	1200
13	Syenite	Quincy, Mass	2.660	166.2	1+650	750	800	850	900	1000
14	Gray	Croton, Conn	2.800	175.0	1+818	700	750	800	900	900
15	Common	Woodstock, Md	2.648	165.5	1+394	700	750	800	900	900
16	"	Port Deposit, Md	2.700	168.7	1+816	800	900	950	1000	1100
17	Scranton County Quarry	Richmond, Va	2.727	170.5	1+398	750	800	850	900	1000
18	Old Dominion Quarry	" "	2.674	167.7	1+402	750	800	850	900	1000
19	Light colored	St. Cloud, Minn	2.690	168.2	1+280	700	700	800	850	900
20	"	Stanstead, P. Q	2.833	177.0	1+420	800	900	1000	1000	1200
21	Coarse	North Halifax, N. S	2.698	168.6	1+584	700	800	800	900	900
22	"	Gauauogue, P. O., Can	2.687	167.9	1+736	800	850	900	950	1000

SANDSTONE.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
1	Freestone	Portland, Conn	2.380	148.7	1+ 27	850	900	950	1000	1100
2	"	North of England	2.163	135.5	1+ 27	850	900	950	950	1000
3	Seneca Stone	Montgomery Co., Md	2.500	156.2	1+ 26	850	900	900	950	950
4	Sandstone	Salem, Md	2.452	153.2	1+ 24	850	900	950	1000	1100
5	"	Seneca, Md	2.410	150.6	1+ 40	900	1000	1100	1200	1200
6	Montrose Stone	Ulster Co., N. Y	2.661	166.3	1+314	900	1000	1100	1200	1200
7	Freestone	Belleville, N. J	2.350	146.8	1+ 27	900	950	1000	1100	1100
8	"	Nova Scotia	2.424	151.5	1+240	900	950	1000	1100	1100
9	S. Carboniferous	Br. Phillipe, N. S	2.353	147.0	1+ 19	900	950	950	1000	1000
10	Freestone	Dorchester, N. B	2.363	147.7	1+ 26	800	850	900	1000	1000
11	Cincinnati Stone	Cincinnati, O	2.188	136.1	1+ 23	900	950	1000	1100	1100
12	Potsdam Sandstone	McBride's Corners, O	2.333	145.8	1+ 28	800	850	900	1000	1100
13	Berlin Stone	Cleveland, O	2.210	138.1	1+ 22	850	900	1000	1100	1100
14	Potsdam	McBride's Corners, O	2.500	156.2	1+ 22	850	900	950	1000	1000
15	Euclid Stone	Near Cleveland, O	2.290	143.1	1+ 35	850	900	950	1000	1000
16	Berea Stone	Berea, O	2.254	140.8	1+ 20	850	900	950	1000	1000
17	Amherst Stone	Amherst, O	2.200	137.5	1+ 18	850	900	changes	color.	1000
18	Brown Stone	Humbletown, Penn	2.346	146.6	1+ 28	850	900	950	1000	1000
19	Potsdam Sandstone	Beauharnois, P. Q	2.512	157.0	1+ 38	850	900	950	1000	1000
20	Sandstone	Murray Bay, P. Q	2.577	161.0	1+ 36	900	950	1000	1100	1100
21	"	Cheat River, W. Va	2.632	164.5	1+ 80	800	850	900	1000	1100
22	Freestone	Acqua Creek, Va	2.183	136.4	1+ 16	900	950	1000	1100	1200
23	Brown Stone	Manasses, Va	2.348	146.7	1+ 17	850	900	1000	1100	1200

LIMESTONE.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
1	Limestone	Baltimore, Md	2.917	131.8	1+340	900	1000	1100	1200	1200
2	"	Bedford, Ind	2.478	154.8	1+280	850	900	1000	1200	1200
3	Cincinnati Limestone	Hamilton County, O.	2.204	137.7	1+ 28	850	900	950	1200	1200
4	Potts Blue	Springfield, Penn	2.666	166.6	1+280	850	850	900	1000	1200
5	Dolomite Limestone	Owen Sound P. O	2.571	160.6	1+480	850	900	1100	1200	1200
6	Trenton Limestone	Montreal, P. Q	2.706	169.1	1+316	900	950	1000	1200	1200
7	Limestone	Isle La Motte, Vt	2.636	168.5	1+320	950	1000	1100	1200	1200

CONGLOMERATES.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
1	Conglomerate	Roxbury, Mass	2.708	169.2	1+49	700	800	900	1000	1000
2	Potomac Stone	Point of Rocks, Md	2.724	170.2	1+60	600	700	800	900	900
3	Conglomerate	Cape a La Aisle, P. Q	2.645	165.3	1+80	600	700	800	900	900

MARBLES.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
						Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1	Tuckahoe	Westchester Co., N. Y.	2.794	194.6	1 + 298	900	1000	1200	1200	1200
2	Ashley Falls	Ashley Falls, N. Y.	2.742	171.3	1 + 280	900	1000	1100	1200	1200
3	Snow Flake	Westchester Co., N. Y.	2.848	178.0	1 + 380	950	950	1000	1200	1200
4	Tennessee	Dougherty's Q'y, E. Tenn	2.711	169.4	1 + 320	950	950	1000	1200	1200
5	Duke Marble	Near Harper's Ferry, Va.	2.812	175.7	1 + 340	1000	1000	1100	1200	1200
6	Black Marble	Isle La Motte, Vt	2.682	176.6	1 + 320	1000	1000	1100	1200	1200
7	Sutherland Falls	Rutland, Vt	2.666	166.6	1 + 342	1000	1000	1100	1200	1200

SLATES.

1	Sabin's Quarry	Montpelier, Vt	2.869	179.3	1 + 110	800	850	900	1000	1200

SOAPSTONES.

1	Soapstone	Weathersfield, Vt	2.668	166.7	1 + 3 8	1200	----	----	----	----

ARTIFICIAL STONE.

1	Artificial Stone	McMurtire & Chamberlain's patent	2.235	139.7	1 + 280	750	800	1100	1200	----

MINERAL WAX, A RESUMÉ.

By M. Benjamin, Ph. B.

Geographical Distribution. Mineral wax or ozocerite (from ὄζειν, to smell, and κηρός, wax) is found in a sandstone in Moldavia, in the vincinity of coal and rock salt. It also occurs in large quantities at Borislav, near Drohobycz, and at Dzwiniacz, near Stainstawow in Galicia, a province of Austria. The mines are situated at the northern foot of the Carpathian Mountains. It has also been found at several other places in the same province. Small quantities have been discovered in England, at Binney Quarry, Linlithgowshire; at the Urpeth Colliery, Newcastle-on-Tyne, and in Wales. In this country it has been found in Texas, in Utah and in California, about fifty miles northeast of Los Angelos, among the Sierra Madre Mountains In Utah the mineral occurs in shale beds, out of which the ozocerite appears as exudations. These shale beds are quite extensive—some forty to sixty miles long by twenty wide, and from seventy to forty feet in thickness. It is thought that by digging and boring the supply of the wax may be increased.

Geologically it is presumed that these beds were formed in a tertiary lake or peat bog. Prof. J. S. Newberry suspects that it will be found to be an evolved product, the distillation of beds of cretaceous lignite and the residue of a petroleum unusually rich in paraffine. The foreign deposits are considered to be about of the same age.

Mode of Occurrence. It is generally found (referring to Galacia) in thin layers and small pieces which must separated from the matrix in which they are found. The smallest pieces are only obtained by a process of washing. It is sometimes found in lumps or layers from one to three feet in thickness, a lump sometimes weighing several hundred weght.

Physical Properties. It is like a resinous wax in consistency and translucency, sometimes with a foliated structure. Its color is brown or brownish yellow by transmitted light and leek green by reflected light. The poorer qualities, which are colored black and are either too soft from abundance of petroleum or too hard (asphalt like in character), are mainly used for the production of paraffin. It possesses a pleasantly aromatic odor. The American variety is described as black in the mass, sections of which are translucent.

Its Chemical Nature. The specific gravity of ozocerite is 0.94 to 0.97. According to Dana it ranges from 0.85 to 0.90.

Its melting point is variously given as follows:

The Moldavian,	84°	Malaguti.
Urpeth mineral,	60°	Johnson.
Galacian,	60°	Höfstadter.
Utah,	61°5	Newberry.
Moldavian,	62°	Schrötter.
From Slanik,	62°	Glocker.
Galacian,	63°	Wagner.

The boiling point is likewise differently given by the authorities:

Urpeth mineral,	121°	Johnson.
Moldavian,	210°	Schrötter.
Moldavian,	300°	Malaguti.
Utah, between	300° and 380°	Newberry.

Concerning this last determination, Dr. S. B. Newberry says; 1.5 grammes of the substance were treated with about 300 c. c. of cold ether, and allowed to stand for twenty-four hours. The substance was decanted through a filter, evaporated, and the resulting mineral tested to obtain the melting point. This treatment gave me a fraction equal to 25.4 per cent. of the original substance, and having a melting point of 49. C. The residue was again treated with 200 c. c. of cold ether for about the same time, and gave a further product equal to 9.1 per cent. of the original mass, fusing at 61°. On boiling the undissolved portion in about 500 c. c. of ether the whole mass went into solution, and upon evaporation was found to have a fusing point of 67°. It distills without decomposition, is not altered by strong acids, and very little by hot alcohol. The Moldavian variety dissolves but slightly in ether, whereas that found at Urpeth dissolves in this medium to the amount of four-fifths, and separates on evaporation in brown flecks, which melt at 38.°9 to a yellowish brown liquid. The solubility of the variety found in Utah has been sufficiently referred to in the remarks on its fusing point. The composition of ozocerite has been found to be:

	Moldavian.		Urpeth.	Utah.
	Malaguti.	Schrötter.	Johnson.	Newberry.
Carbon	85.75	86.20	86.80	86.15
Hydrogen	15.15	13.77	14.06	13.75
	100.90	99.97	100.86	99.90

It is supposed to be a compound of several members of the paraffine series, which are represented by the general formula $C_n H_{2n+2}$, and perhaps containing certain of the olefines $C_n H_{2n}$, a very full description of the chemical composition of a nodule of ozocerite found at Kinghornness, Scotland, was given in a paper read by W. Ivison Macadam, at the Sheffield meeting of the British Association,* last year.

Process of Manufacture. The crude mineral (ozocerite) is melted with water in order to remove any sand or other earthy impurities with which it is likely to be mixed. It is then run into cakes weighing about two pounds each. Another authority states that crude hydrocarbon is first melted and drawn off; the residue boiled with water, to the surface of which any remaining ozocerite rises; the whole allowed to stand for several hours for any suspended impurities to settle out. The melted wax which was drawn off is poured into moulds, which hold from 100 to 120 pounds. These cakes are then shipped to the various factories in England, Moldavia and Vienna, where it is purified and converted into illuminating oils and paraffine. A portion of it is directly treated on the island of Swatoi Astrow, in the Caspian Sea, near the Peninsula of Apscheron. There it is distilled in flat bottomed iron retorts provided with leaden worms, each of these retorts holding from 1,500 to 2,000 pounds.

Sixty-eight per cent. of distillate is obtained, sixty parts of which are paraffine and eighty parts oil. According to Grabowsky, the products of such a working may be tabulated as:

Benzine	2 to 8 per cent.
Naptha	15 to 20 " "
Paraffine	36 to 50 " "
Heavy lubricating oils	15 to 20 " "
Coke	10 to 20 " "

The oil thus obtained is yellow, opalescent, possesses an ethereal odor, and has a density varying between 0.75 and 0.81. Each distillate yields a quantity of a light oil boiling below 100°, which is used for purifying the paraffine, as will be shown further on. The crude paraffine thus obtained from the first distillation is yellow in color and tolerably pure. It is treated by the hydraulic press and the expressed oil redistilled in order to obtain any remaining paraffine. The pressed paraffine is melted and treated at from 170° to 180° with five per cent. of sulphuric acid, washed, neutralized with lime, and then rapidly distilled, then cast in plaques and again pressed. The cakes thus obtained are treated with twenty-five per cent. of the light oil and again melted and pressed; finally, they are treated with steam for the purpose of eliminating the last traces of essential oil. The material resulting from this treatment is a perfectly pure and colorless substance, free from all odor, transparent, and so hard as to exhibit in large blocks an almost metallic sound.

An improved method of bleaching ceresine, paraffine, petroleum, stearine and other fatty matters has been patented in Germany within a few months. The process consists in heating ozocerite to 170°–200° C. About twenty per cent. of the hydroxides of aluminium, iron, manganese and magnesium or the silicates of aluminium and magnesium are added to the molten mass. The treatment is repeated several times with the clear liquid, which separates upon standing. The residues are then treated with steam to remove ceresine and to restore the hydroxides.

* See *Chemical News*, vol. XL, p. 148.

TEXTILE FABRICS OF THE ANCIENT INHABITANTS OF THE MISSISSIPPI VALLEY.*

By Judge J. G. Henderson.

He showed that the modern Indians and these ancient people are bound together by a similarity in the instruments and processes of spinning and weaving. The materials used were the bark of various trees, the nettle, and the hair of the bear, buffalo, deer and dog. In working up the vegetable substances, the bark was first macerated. After being dried, it was spun in a multitude of ways. The rudest process was rolling on the thigh. The next step was a rude spindle which passed through various processes of evolution to the modern spinning-wheel. The speaker then proceeded to show the gradation of elaboration through which the loom has passed into the process of weaving. Judge Henderson's paper was illustrated by a series of drawings, collection of raw materials, and models of spindles and looms.

OCCURRENCE OF TIN AT WINSLOW, ME.*

By Professor C. H. Hitchcock.

After exhibiting specimens of the ore, etc., which is ordinary tin-stone, and is associated with margarite, fluveite, beryl and arsenical pyrites, Professor Hitchcock observed that there are twelve veins of this ore, in twenty feet of rock, their geological relations being identical with those of the tin veins of Cornwall. A bar of tin weighing fourteen ounces was also shown; it is the largest bar ever made in this country. Professor Hitchcock considers this locality the most promising tin-bearing locality yet discovered in the United States.

MICROSCOPY.

At a meeting of the State Microscopical Society of Illinois, held at Chicago, on the 8th ultimo, a new Microscope stand was exhibited by Mr. W. H. Bullock, specially designed for lithological work.

"The stage was made to rotate concentrically on the same plan adopted in his large instruments, and was graduated to read with a vernier to minutes. Both the minor and sub-stage were mounted on graduated circles, and arranged so as to swing over the stage, either separately or in unison. The sub-stage was made in two cylindrical fittings. The lower one carrying the polarizing prism, could be readily swung to one side, while the upper carried the achromatic condenser. The polarizing prism was mounted with a circle graduated to degrees, and was fitted with a stop for marking the position of the prism. The analyzer was mounted above the objective, somewhat after the manner of a Wenham prism, and could be slid in and out of position with the same facility, and also carried, if desired, a quartz film. It was, he said, a matter of great convenience for the lithologist to be able to pass from the use of ordinary to that of polarized light, without loss of time, and with the instrument on exhibition, this change could be effected in less time than a change of objectives with a double nose piece. The stand was also provided with a goniometer eye-piece, which was fitted with a calc film and and analyzing prism, both separable at pleasure."

The instrument, as above described, appears to be well adapted for the end in view, but we would remind Mr. Bullock that Swift, of London, has arranged the polarizing prism and the analyzer in equally convenient positions for instant use; the former he attached to his patent condenser, under the stage, while the analyzer was fitted exactly as Mr. Bullock described. Such instruments have been made for upwards of ten years, and have been used in this country.

Mr. Beck, of London, who was present, must have been quite familiar with the instrument we have described. We have always found the arrangement to work admirably, and are surprised that makers do not generally adopt the system in all Microscopes.

* Read before the A. A. A. S., Boston, 1880.

SWIFT'S COMET.

The comet discovered by Swift on the 10th of October last, has again attracted general attention from the announcement by Mr. Chandler in *Special Circular No. 7*, to SCIENCE OBSERVER, that it seems to be identical with Comet III., 1869 (Tempel), and from the announcement by the Astronomer Royal to the Smithsonian Institution, of a comet discovered by Lohse, at Lord Lindsay's observatory, Dun Echt, November 7, which proves to be an independent discovery of the same object. It has already been followed for nearly a month by astronomers in America, and its elements were computed by Mr. Chandler as accurately as possible from the data at hand.

The following observations made by Prof. Eastman with the Transit Circle of the Naval Observatory, Washington, together with the resulting elements and ephemeris computed by Mr. Upton, have been kindly furnished for publication.

COMET, SWIFT, 1880.

Observations made with the Transit Circle at the Naval Observatory, Washington, D. C.:

	R. A. H.	M.	S.	Decl.		
October 25	21	50	8.74	+ 28°	29′	4″.9
November 1	22	12	33.12	35°	32′	48″.1
" 7	22	45	6.26	42°	26′	8″.3

ELEMENTS.

T = 1880. Nov. 8.00411, Wash. M. T.

$$\left.\begin{array}{l} \pi = 42^\circ \quad 2' \quad 13'' \\ \Omega = 295 \quad 48 \quad 23 \\ \iota = 7 \quad 22 \quad 16 \end{array}\right\} \text{Mean Eq. 1880.0.}$$

log. q = 0.04220.

COMPUTATION OF MIDDLE PLACE.

Obs. Comp.

$$d\lambda \cos\beta = -15''$$
$$d\beta = +4''$$

EPHEMERIS. WASHINGTON—MEAN MIDNIGHT.

Date.	R. A. H.	M.	S.	Decl.		Intensity of Light.
1880—November 16	0	13	15	+ 52°	8′.7	1.11
" 20	1	7	41	54	31.2	1.08
" 24	2	5	44	54	59.6	0.99
" 28	2	59	22	53	38.8	0.86
December 2	3	43	26	51	2.5	0.72
" 6	4	17	21	47	50.5	0.58

In order to show the remarkable accordance with the elements of III., 1869, we give the elements of this latter comet as published by Dr. Bruhns, Astron. Nach. 1788:

COMET III., 1869.

T = 1869, Nov. 20. 85426. Berlin, M. T.

$$\left.\begin{array}{l} \pi = 41^\circ \quad 17' \quad 12''.5 \\ \Omega = 292^\circ \quad 40' \quad 28''.8 \\ \iota = 6^\circ \quad 55' \quad 0''.0 \end{array}\right\} \text{Mean Eq. 1870.0}$$

log. q. = 0.042416.

Assuming the two to be identical, and the comet to move in an eclipse having a period of 12 days less than 11 years, we shall have—

Semi-major axis = 4.93589
Eccentricity = 0.7767.

The intensity of light on November 7 is taken as unity. On this scale the intensity on October 10, when the comet was discovered, was 0.36. It reaches a maximum brightness about November 16, and it is probable that observations can be continued till near the end of the year, before the comet becomes too faint.

It presents an ill-defined disc, several minutes in diameter, but owing to the brightness of the moon, it can be seen for the next week, only with the larger instruments. If the identity of these two comets is finally established, and there seems to be no reasonable doubt of it now, a recomputation of the elements, embodying all the reliable observations made in 1869, will be very desirable, and will doubtless soon be undertaken. W. C. W.

WASHINGTON, *Nov.* 15, 1880.

THE NEW PERIODIC COMET.

This comet, discovered by me at midnight of October 10–11, is destined, from present indications, to become one of considerable celebrity, notwithstanding it will not be visible to the naked eye. The computation of the elements of its orbit reveals the fact that they are almost identical with those of Comet III., 1869, and hence it becomes what in astronomical language is called a periodic comet. This will have a period of not over 11, and probably only 5½ years, in which case it must have returned unobserved to perihelion about the middle of the year 1875. In either case it will be a periodic comet of short period.

I am indebted to the kindness of Prof. S. C. Chandler, Jr., of Boston, for the following set of elements, which, however, owing to the inexact determinations of the three positions used for their computation, must, of course, be considered only as approximations. They are, no doubt, near enough to the truth to establish the fact that Comet IV., 1880, is a return of Comet III., 1869, for it is almost an impossibility for two different comets to come into our system possessing physical characteristics so similar, and having elements so nearly alike. I copy both sets of elements for comparison:

	Comet III., 1869.	Comet IV., 1880.
Per. passage.	Nov. 20.854.	Nov. 7.714.
	° ′ ″	° ′
Lon. per.	41 17 12.5	41 41
Lon. node	292 40 28.8	295 25.4
ι	6 55 0	7 21.7
Log. q.	0.042416	0.04262
Motion.	Direct.	Direct.

If the above supposition regarding the identity of the two comets be true, it will add another to the list of periodic comets, bringing the number up to eleven. Their names are as follows:

Name.	Period.
Halley's	76.75 years.
Encke's	3.30 "
Winnecke's	5.54 "
Brorsen's	5.58 "
Biela's	6.61 "
D'Arrest's	6.64 "
Tempel's (1867)	6.00 "
Tempel's (1873)	5.16 "
Faye's	7.44 "
Tuttle's	13.66 "

From the above list I have rejected Dé Vico's comet, which should not have been placed there, as the supposed periodicity has never been verified by an observed return.

There can be but little doubt that to this list should be added comet I, 1880, commonly called the great South American comet, with elements and general appearance almost identical with the great comet of 1843, one of the most remarkable comets mentioned in history. It was seen in the daytime, close to the sun's limb, glowing like a coal of fire. Of all known comets, it has made the nearest approach to the sun. It was truly said of it: "It exhausted its head in the manufacture of its tail," for it was nearly all tail.

As an evidence of the advance which cometary astronomy has made in our times, it may be stated that up to 1822 one only, (Halley's) periodic comet, was known. The number of such is doubtless very great, in fact computation makes the number several hundred, but until

verified by actual returns to perihelion, the question of periodicity cannot be affirmed with positiveness. Every few years a new one is added to the list, but during the centuries and milleniums which are to come, the number must swell to thousands.

Prof. Chandler is computing a new set of elements from more trustworthy data, but, as the comet is running well with those first published, the new set will probably differ but little from the first. The discovery of this comet was immediately cabled to Europe, and I have received official announcement that the cablegram was duly received, but it seems that it was not discovered there until November 7, when, not knowing but it might possibly he a new one, it was cabled here as such.

It has never, to my knowledge, been published in this country, that the Vienna Academy has rescinded its offer of prizes for the discovery of comets; therefore I expect no gold medal for the discovery of this, but your readers may be surprised, perhaps pleased, to learn that Mr. H. H. Warner, the well-known medicine man, who is building the new observatory for my use, gave me his check for $500 for its discovery. This, together with the three gold medals awarded me by the Imperial Academy of Sciences of Vienna, is a partial remuneration for the labor and the unknown suffering endured from cold and want of sleep during the many years I have followed comet seeking in the open air, with no protection from the piercing winds of our northern winters.

The following are a few positions of the comet from Chandler's ephemeris for Washington midnight.

	h.	m.	s.		°	′
November 20	1	9	18	Dec. +	54	3
24	2	6	19		54	25
28	2	58	39		53	3

LEWIS SWIFT.

ROCHESTER, *Nov.* 17, 1880.

COMET E 1880.

This comet, discovered by Mr. Swift on October 10th, proves to be an interesting object. An orbit has been computed by Mr. Winslow Upton, of the Naval Observatory, from the observation made here by Professor Eastman, and there can be no doubt that this is a return of the comet discovered by Mr. Tempel, November 27, 1869, since the elements of the two orbits are very nearly alike. The periodic time of this comet is therefore nearly eleven years, and its mean distances from the sun is a little less than that of Jupiter. A. HALL.

WASHINGTON, *Nov.* 11, 1880.

ASTRONOMICAL NOTES.

THE corrections employed in reducing the double star observations of M. Otto Struve, given in Vol. IX., of the Poulkova observations were only provisional. Since the publication of that volume definitive corrections have been computed by M. Dubiago, and the corrected results are now published as an appendix.

AT the meeting of the American Association this Summer, Professor Stone gave a description of the continuation of Argelander's *Durchmusterung* now in progress at the Cincinnati Observatory. The zone will extend from 23° to 31° south declination. A four inch equatorial is employed.

PART III of the *Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac* is devoted to Master Michelson's determination of the velocity of light. A minute description of the apparatus employed is given, together with the determination of the errors to which the observations were subject. In the latter part of the work several objections to the plan followed by Foucault are considered.

VOL. VI, of the *Annales de l'Observatoire de Moscow* contains an interesting series of observations of Jupiter made during the opposition of 1879. Nearly forty drawings are given, twenty-seven of which were made at times when the large red spot was visible.

AN attempt to photograph stellar spectra was made by Drs. Huggins and Miller, as long ago as 1863, but not with the best of success. Dr. Huggins has published in the last volume of the Philosophical Transactions, the results of a recent, and this time successful, attempt, and at the end of the paper has given a map of the spectra of several of the stars observed. These are α Lyrae, Sirius, η Ursae Majoris, α Virginis, α Aquilae, α Cygni, and Arcturus. With the exception of the latter these are all white stars and were observed on account of the remarkable circumstance of the absence of the K line in one of the earlier photographs of Sirius. "The photographs present a spectrum of twelve very strong lines. Beyond these lines a strong continuous spectrum can be traced as far as S, but without any further indication of lines. The least refrangible of these lines is co-incident with the line (ζ) of hydrogen near G. The next line in order of greater refrangibility agrees in position with *h* of the solar spectrum. The thirdl ine is H, K, if present at all, is thin and inconspicuous. The nine lines which follow do not appear to be co-incident with any of the stronger lines of the solar spectrum." The symmetry of arrangement of these lines is such as to suggest that they are the spectrum of a single substance, perhaps hydrogen.

The spectrum of Arcturus is very different from that of the other stars named, but quite similar to that of the sun. The spectrum is crowded with a vast number of fine lines, and in further contrast with the class of white stars the line K is very broad and winged and more intense than H. Beyond K the lines are broader and more intense and arranged more or less in groups with fine lines between. Although the crowding continues as far as the spectrum can be seen on the plate the position and arrangement of the lines beyond H is quite different from those in the solar spectrum.

Photographs of the spectra of Venus, Mars and Jupiter were also taken, but these showed no modification whatever of the solar light. In the case of the moon most of the photographs presented differences in the relative intensity of the ultra violet region, but nothing that could be taken as evidence of the existence of a lunar atmosphere. O. S.

Prof. C. A. Young, of Princeton, has been fortunate enough to obtain one of the finest large-crown glass discs ever cast. It is of French manufacture, 22 inches in diameter and without a flaw. Alvan Clark & Sons are finishing it for the new Princeton refractor.

Dr. B. A. Gould, Director of the Cordoba Observatory, Argentine Republic, was in Boston, November 3, on a visit to this country and returns to Cordoba on the steamer of the 27th November. His address is 110 Marlboro street, Boston.

Dr. Elkin, whose work on the Parallax of α Centauri has been previously noticed, is spending a few weeks in Washington. He expects to leave shortly for the Cape of Good Hope, where he will continue his investigations upon the Parallax, using for that purpose Lord Lindsay's four-inch Heliometer, which he is to take out with him.

W. C. W.

BOOKS RECEIVED.

BRITISH THOUGHTS AND THINKERS—INTRODUCTORY STUDIES—CRITICAL, BIOGRAPHICAL AND PHILOSOPHICAL. By George S. Morris, A. M. Lecturer on Philosophy in the Johns Hopkins University, Baltimore—S. C. Griggs and Company, Chicago. 1880.

To trace the progress of the human mind and its highest aspirations, must always demand the close attention of an author of the highest intelligence and perfectly unbiased reasoning faculties ; because it is easy to understand that, with such a mass of material to draw from, deductions of the most varied character may be drawn, which may accord with almost any form of belief or system of philosophy, by a mere judicious selecting and rejection of authorities.

The present author has evidently commenced his task with certain philosophical convictions strongly established in his own mind, and the purpose of his book is to place them in proper order before his readers, showing the high authorities that may be cited for their support and as evidence of their truth.

The aim of Professor George S. Morris is to assert the idealism which is innate in the universal mind of man, which is no accident, but a constituent and necessary element of human nature, and in fact, that which constitutes it. This idealism teaches mind to have faith in itself, to know itself. He refers to mind, or conscious intelligence, as an active function, not simply a passive possession; strictly passive, it were no longer intelligence, for then inactive, it would not have intelligence of itself. He states still further that intelligence is only of the intelligible, reason apprehends only what is rational—mind therefore can comprehend no world which is not permeated with its own attributes; the absolutely unintelligible, irrational, being inconceivable, and hence utterly incapable of being brought into relation to mind is for it no better than the non-existent.

Mind therefore seeks itself in the universe, chiefly in forms of law, order, purpose, beauty—it must reduce its conception of the universe, given first in the form of isolated, unexplained impressions, to the order and harmony of a rational and hence explicable apprehensible whole. And this search, this necessity of mind, again, precisely, is *idealism*.

Such in the view of Professor Morris, is the law, the universal tendency and the inherent necessity of mind.

Man having no exact conception of an idea apart from the mind which possesses it, cannot conceive rationality, except as the attribute and living function of a mind or spirit. The rationality therefore found in nature is an *absurdum* unless viewed as the direct or indirect effect and function of self-conscious spirit. The idealism (in theory) which holds fast to these axioms, acknowledges God, whose rational power and wisdom it detects in all things. So man in his humble way is brought into direct and sympathetic relation with the universal, all-pervading, all-explaining power.

Such being the strong belief of Professor Morris he naturally reads with horror, in the works of Mr. Herbert Spencer, of Man being merely sensitive flesh, and morality the irresponsible result of physico-organic evolution, and not the self sustaining work or requirement of the ideal true man.

As representatives of two opposite shades of opinion, it would scarcely be possible to select more appropriately, two men with more divulgent views than Professor Morris and Mr. Spencer. The former sees no limit to the possibilites of his system of reasoning, while the latter insists that whatever is not cognizable, through the investigations of phenomena by the peculiar method, and with the peculiar and generally recognized limitations of physical science, is arbitarily held to be unknowable.

It is clear that Professor Morris approaches the subject of Mr. Spencer's system of philosophy strongly biased against it, and when he stigmatizes Spencer's views as gratuitous, extra-scientific, absurd, contradictory and dogmatic, we would caution students, for whom this work is principally written, to read the works of Spencer before accepting Professor Morris's conclusions.

The work which we now review will doubtless command a large circulation. It was founded on a course of lectures delivered at the Johns Hopkins University, Baltimore, and is, therefore, well adapted for students, but as a work for the general reader it will prove highly attractive, presenting in a small compass a synopsis of the works and record of the lives of such men as Edmund Spenser, Richard Hooker, Shakespeare, Bacon, Hobbes, John Locke, George Berkeley, David Hume, Sir William Hamilton, John Stewart Mill, Herbert Spencer, and others.

Credit is due to Professor Morris for his skillful method of handling subjects presenting so many difficulties, and the general arrangement of the work is harmonious, consistent and intelligible. The appearance of this work at the present time is most opportune, and as an introduction to the line of thought which speculative philosophy has taken, from Lord Bacon's time to the present day, a more useful book cannot be selected. The deliberate opinions, so forcibly and ably engrafted throughout the work, while merely intended to point the way to correct views, considered from the position taken by the author, may even carry conviction with them. We, however, strongly advise the student to accept the book in the spirit in which it is offered, and to regard it as an invitation to reflection and more systematic study rather than as a substitute for it.

PHYSICAL NOTES.

POLAR ELECTRICITY IN THE HEMIHEDRAL CRYSTALS WITH INCLINED SURFACES.—MM. Jacques and Pierre Curie have shown that all the facts hitherto observed agree in showing that in all the non-conductive substances with inclined surfaces which have been examined there is the same connection between the position of the hemihedral facettes and the direction of the phenomenon of polar electricity. The physical signification of the above will be better understood by saying more colloquially, but more tersely, that the more pointed extremity of the hemihedral form corresponds to the positive pole by contraction, whilst the more obtuse extremity corresponds to the negative pole.—M. P. Thenard claims that the same phenomenon was observed by his son fifteen years ago.

PRODUCTION OF CRYSTALS OF CHROMIUM SESQUICHLORIDE OF A PERSISTENT GREEN COLOR.—M. A. Mengeot allows hydrochloric acid to act upon potassium bichromate dissolved in water. If the solution is allowed to evaporate for about ten months the bottom of the vessel is found lined with deep violet crystals of chromium sesquichloride, but among these large violet crystals are some small green crystals of a salt of chromium. According to all authorities the green salts are only formed at 100° ; they are not crystalline, and they gradually pass into the violet condition. But the production of these green crystals takes place at common temperatures, and they have remained green for more than two years.

RESEARCHES ON BASIC SALTS AND ON ATACAMITE.—M. Berthelot considers that in this compound, $CuCl,3CuO,4HO$, the water serves as the chief connecting link. A metallic salt may be completely precipitated and the resulting liquid neutralized without an equivalence between the precipitating alkali and the acid of the metallic salt, a portion of the lattar being carried down in the precipitate. A great number of metallic salts behave in an analogous manner. M. Berthelot has also found that the transformation of the simple ethers into alcohols corresponds in a state of solution to a thermic phenomenon, which is almost *nil*.